Designation: C 233 – 01

Standard Test Method for Air-Entraining Admixtures for Concrete[1]

This standard is issued under the fixed designation C 233; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers the testing of materials proposed for use as air-entraining admixtures in the field.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information purposes only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 The text of this test method references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

C 33 Specification for Concrete Aggregates[2]

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens[2]

C 78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)[2]

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[2]

C 143/C 143M Test Method for Slump of Hydraulic Cement Concrete[2]

C 150 Specification for Portland Cement[3]

C 157 Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete[2]

C 172 Practice for Sampling Freshly Mixed Concrete[2]

C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method[2]

C 185 Test Method for Air Content of Hydraulic Cement Mortar[3]

C 192/C 192M Test Method for Making and Curing Concrete Test Specimens in the Laboratory[2]

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method[2]

C 232 Test Methods for Bleeding of Concrete[2]

C 260 Specification for Air-Entraining Admixtures for Concrete[2]

C 403/C 403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance[2]

C 666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

D 75 Practice for Sampling Aggregates[4]

D 1193 Specification for Reagent Water[5]

E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode[6]

2.2 *ACI Standards:*

ACI 211.1 Recommended Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete[7]

3. Significance and Use

3.1 This test method is used to develop data for comparison with the requirements of Specification C 260. These tests are based on arbitrary stipulations permitting highly standardized testing in the laboratory, and are not intended to simulate actual job conditions.

4. Materials

4.1 *Cement*—The cement used in any series of tests shall be either the cement proposed for specific work in accordance with 4.4, a Type I or Type II cement conforming to Specification C 150, or a blend of two or more cements, in equal parts. Each cement of the blend shall conform to the requirements of either Type I or Type II, Specification C 150. If a blend of cements is used, it shall be a combination which produces an air content of less than 10 % when tested in accordance with Test Method C 185 (Note 3).

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.23 on Chemical Admixtures.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.01.

[4] *Annual Book of ASTM Standards*, Vol 04.03.

[5] *Annual Book of ASTM Standards*, Vol 11.01.

[6] *Annual Book of ASTM Standards*, Vol 15.05.

[7] American Concrete Institute Manual of Concrete Practice, Part 1, pp. 211-1 to 211-38 (1993).

***A Summary of Changes section appears at the end of this standard.**

4.2 *Aggregates*—Except when tests are made in accordance with 4.4, using the aggregates proposed for specific work, the fine and coarse aggregates used in any series of tests shall come from single lots of well-graded, sound materials that conform to the requirements of Specification C 33, except that the grading of the aggregates shall conform to the following requirements:

4.2.1 *Fine Aggregate Grading*—The fine aggregate shall meet the requirements for the fine aggregate in Specification C 33.

4.2.2 *Coarse Aggregate Grading*—The coarse aggregate shall meet the requirements for size number 57 of Specification C 33.

NOTE 1—Take care in loading and delivery to avoid segregation.

4.2.3 The coarse aggregate used for each set of reference concrete and comparable test admixture-treated concrete shall be essentially the same. Therefore, a set of test concrete consists of one reference concrete and as many test admixture-containing concretes as are intended to be compared to that one reference. Thus, coarse aggregate for one set shall consist of enough material for one reference concrete, the test admixture-containing concrete to be compared with that reference, and the sample for grading analysis testing.

4.2.3.1 Prepare coarse aggregate for a set, comprising a sample large enough for concrete trials, as follows: Fill tared containers, one each for a sample, a batch of reference concrete and one or more test concretes to the required mass from the aggregate stockpile. Accomplish this by starting with a scoopful into the first container and repeat this procedure until all containers have their required mass. Repeat the process for each of the three or more sets needed. One or more spare sets may be needed. See the Appendix of Practice D 75, Sampling from Stockpiles, and the Manual of Aggregate and Concrete Testing[2] for guidance for conditions and procedures.

4.2.4 Test coarse aggregate samples representing each set by Test Method C 136 requirements for the sieves shown below. Discard any set for which the sample does not comply with Size 57. Average test results for samples which comply with Size 57 for each sieve size. Discard any set for which the sample deviates from this average by more than the amount shown in column 3. Continue the process of preparation, testing and averaging until sufficient sets of aggregate within tolerance are obtained.

Sieve	Specification C 33, No. 57 Percent Passing	Maximum variation from average/passing
37.5-mm	100	00
25.0-mm	95 to 100	1.0
12.5-mm	25 to 60	4.0
4.75-mm	0 to 10	4.0
2.36-mm	0 to 5	1.0

NOTE 2—All of the results required for demonstrating compliance under this specification are dependent on the uniformity of the aggregate samples prepared and used. Careful, skilled and well-supervised work is essential.

4.3 *Reference Admixture*—For this test method, unless otherwise requested by the purchaser, the reference admixture used in the concrete mixture specified in Section 4 shall be "neutralized Vinsol resin."[8]

4.4 *Materials for Tests for Specific Uses*—When it is desired to test an air-entraining admixture for use in specific work, the cement and aggregates used shall be representative of those proposed for use in the work, and the concrete mixtures shall be designed to have the cement content specified for use in the work (Note 3). If the maximum size of coarse aggregate is greater than 25.0 mm (1 in.), the freshly mixed concrete shall be screened over a 25.0-mm (1-in.) sieve prior to fabricating the test specimens in accordance with the wet sieving procedure described in Practice C 172.

4.5 *Preparation and Weighing*—All materials shall be prepared and all weighings shall be made as prescribed in Test Method C 192/C 192M.

NOTE 3—It is recommended that whenever practicable, tests be made in accordance with 4.4 using the cement and pozzolanic or chemical admixtures, if any, proposed for specific work.

5. Concrete Mixtures

5.1 *Proportions*—Using ACI 211.1, all concrete shall be proportioned to conform to the following requirements:

5.1.1 The cement content shall be 307 ± 3 kg/m^3 (517 ± 5 lb/yd^3) except when tests are being made for specific uses (see 4.4).

5.1.2 The first trial mixture shall contain the amount of coarse aggregate shown in Table 6.3.6 of ACI Recommended Practice 211.1 for the maximum size of aggregate and for the fineness modulus of the sand being used.

NOTE 4—Values in Table 6.3.6 of ACI Recommended Practice 211.1-77 are intended to ensure workable mixtures with the least favorable combinations of aggregate likely to be used. It is suggested, therefore, that for a closer approximation of the proportions required for this test, the values selected from Table 6.3.6 be increased by about 7 % for the first trial mixture.

5.1.3 The air content used in the computation of proportions for all concrete shall be 5.5 % except where the admixture under test is for use in specific work (see 4.4). In this case the air content used in selecting proportions shall be the median of the range to be permitted in the work. If lightweight aggregates are to be used in specific work, the unit weight of concrete used in selecting proportions shall be the median of the range permitted in the work.

5.1.4 The water content and sand content shall be adjusted to obtain a slump of 90 ± 15 mm (3½ ± ½ in.). The workability of the concrete mixture shall be suitable for consolidation by hand rodding and the concrete mixture shall have the minimum water content possible. These conditions shall be achieved by final adjustments in the proportion of fine

[8] Vinsol resin is manufactured by Hercules Inc., Wilmington, DE. Neutralization may be accomplished by treating 100 parts of the Vinsol resin with 9 to 15 parts of NaOH by weight. In an aqueous solution, the ratio of water to the resinate shall not exceed 12:1 by weight.